USER MANUAL

Netbiter IO Extender

4RO | 6RTD | 8DIO | DAIO | 8AIV | 8AIIS

Doc ID: HMSI-27-228
Version: 2.0

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1 Preface

1.1 About This Document

This manual describes how to install and configure Netbiter I/O Extender modules.

For additional related documentation and file downloads, please visit the Netbiter support website at www.netbiter.com/support.

1.2 Document history

Summary of recent changes

Change	Where (section no.)
New structure and layout.	—
Updated or replaced all graphics.	—
Renamed DIP switch 10 to switch 0 (same as on hardware).	—
Simplified DIP switch descriptions in all module sections.	—
Added ESD warning	*3.2*
Added a general DIP switch description.	*3.5*
Removed Modbus Register Types table.	*3.7*
Added Modbus Function Codes table.	*3.7*
Removed incorrect info about DIP switch 9.	*6*
Removed info about 8AII and 8AIVS modules.	*8*, *9*
Added Regulatory Conformance section	*10*

Revision list

Version	Date	Author	Description
1.20	Feb 2014	SDa	
2.00	Sep 2015	ThN	Multiple corrections and updates New layout

1.3 Conventions

Unordered (bulleted) lists are used for:

- Itemized information
- Instructions that can be carried out in any order

Ordered (numbered or alphabetized) lists are used for instructions that must be carried out in sequence:

1. First do this,
2. Then open this dialog, and
   a. set this option...
   b. ...and then this one.

Bold typeface indicates interactive parts such as connectors and switches on the hardware, or menus and buttons in a graphical user interface.

```
Monospaced text is used to indicate program code and other
kinds of data input/output such as configuration scripts.
```

This is a cross-reference within this document: *Conventions, p. 4*

This is an external link (URL): www.hms-networks.com

This is additional information which may facilitate installation and/or operation.

This instruction must be followed to avoid a risk of reduced functionality and/or damage to the equipment, or to avoid a network security risk.

Caution
This instruction must be followed to avoid a risk of personal injury.

WARNING
This instruction must be followed to avoid a risk of death or serious injury.

2 Overview

2.1 Introduction

The Netbiter I/O Extender series provides a solution for distributed I/O requirements. The I/O system consists of stand-alone digital and analog input/output modules connected together on a RS-485 two-wire multi-drop network.

The modules communicate using the Modbus RTU protocol. The 32-bit ARM CPU in the module provides high speed data processing and fast communication turnaround times. Multiple baud rates are selectable, from 2400 to 115200 baud.

All I/O modules fit directly onto an industry standard DIN rail. All modules have a minimum isolation of 1000 VAC rms between the field and logic.

The modules are equipped with status LEDs to indicate the status of the inputs and outputs. This visual indication assists with fault finding and diagnostics.

2.2 Data acquisition

The primary use of the Netbiter I/O Extender modules is for data acquisition in combination with a Netbiter EasyConnect or Netbiter WS gateway. The Netbiter gateway acts as a Modbus master which retrieves and sends data from the Netbiter I/O Extender modules.

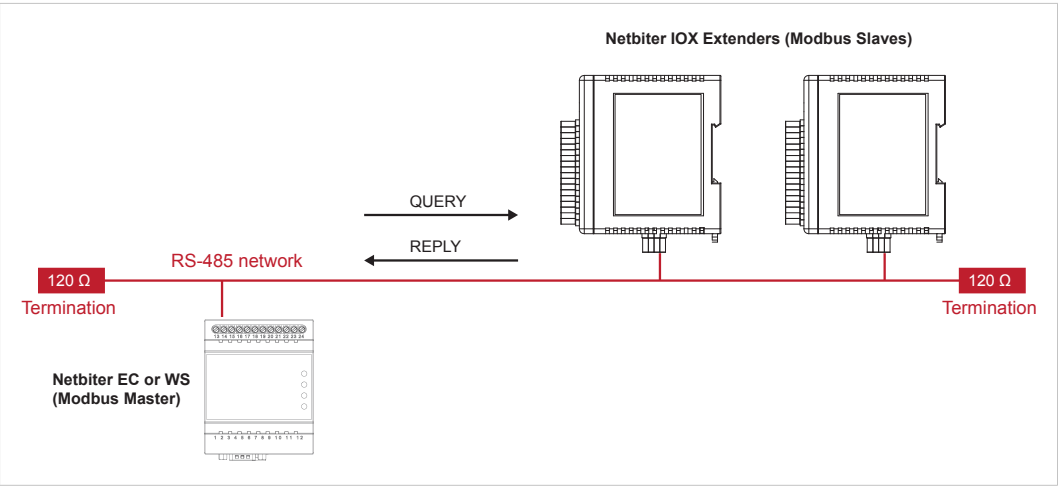


Fig. 1 Overview

2.3 Selection Guide

Module	Type
IOX-4RO	4 relay outputs
IOX-8DIO	8 digital inputs / 8 digital outputs
IOX-6RTD	6 RTD inputs – PT100, Ni120, PT1000, Ni1000, Ni1000LG & Ohms
IOX-DAIO	2 RTD inputs, 2 analog inputs 0(4)-20mA or 0(2)-10V 1 analog output 0(4)-20mA or 0(2)-10V 4 digital inputs, 2 digital outputs
IOX-8AIV	8 analog inputs, 0(2)-10V
IOX-8AIIS	8 fully isolated analog inputs, 0(4)-20mA

3 General/Common Characteristics

3.1 Dimensions

- The module clips directly onto an industry standard DIN rail (EN 50022).
- Field wiring is on the front of the module via a plug-in connector.
- Module power and RS-485 communications wiring are on a separate plug-in connector on the bottom side of the housing.
- Allow at least 25 mm in front of and below the module to accommodate the wiring.
- Ensure that the space above and below the module is sufficient to provide adequate ventilation.

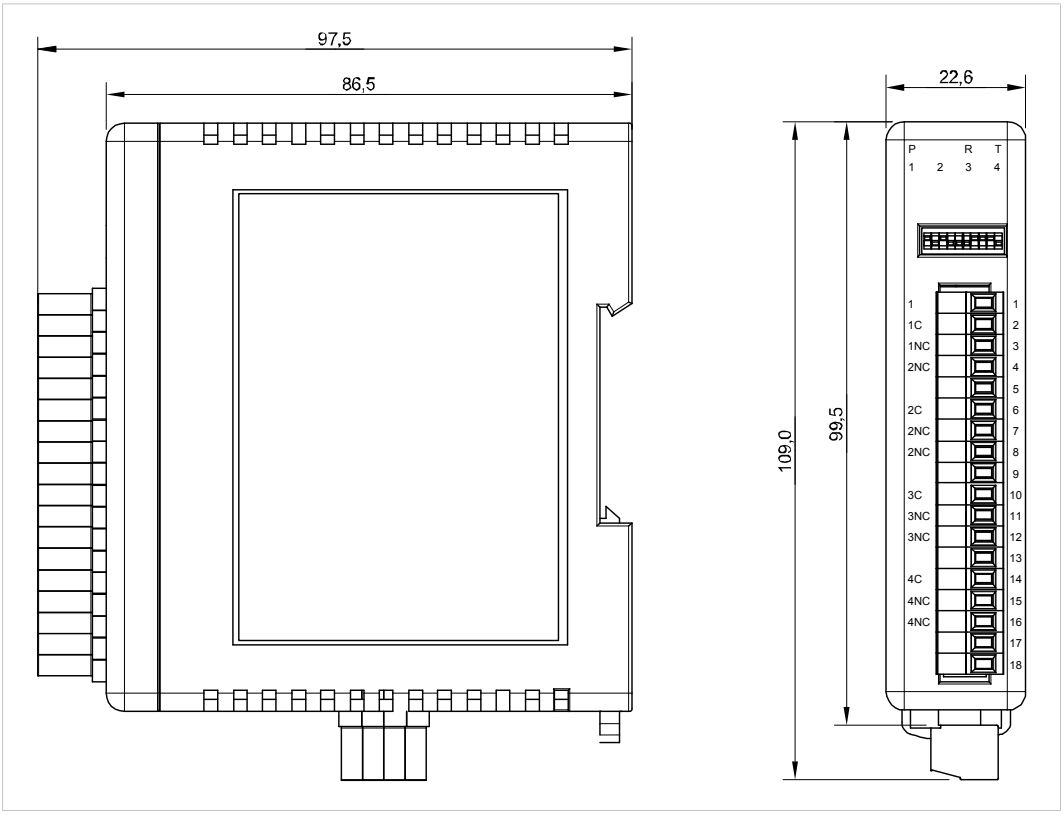


Fig. 2 Netbiter I/O Extender enclosure

3.2 Common Specifications

Operating temperature	-10 °C to +50 °C
Storage temperature	-40 °C to +85 °C
Humidity	5–95 % RH, non-condensing

> ! *This product contains parts that can be damaged by electrostatic discharge (ESD). Use ESD protective measures to avoid equipment damage.*

3.3 EMC Considerations

The I/O modules will usually be installed in an enclosure along with other devices that generate electromagnetic radiation, such as relays and contactors, transformers, motor controllers, etc. Electromagnetic radiation can induce electrical noise in both power and signal lines. Direct radiation into the module can also have a negative effect on the system.

Appropriate grounding, shielding and other protective steps should be taken at the installation stage to prevent interference. Protective steps include control cabinet grounding, module grounding, cable shield grounding, protective elements for electromagnetic switching devices, correct wiring, as well as the consideration of cable types and their cross sections.

- Use screened twisted pair RS-485 cable with the screen grounded at one point.
- Use screened I/O, T/C, and RTD cables, with the screens grounded at one point as close as possible to the I/O module.

3.4 Network Termination

Transmission line effects often present a problem on data communication networks. These problems include reflections and signal attenuation.

If it should be necessary to eliminate reflections from the ends of the cable, the cable can be terminated with a resistor across the line equal to its characteristic impedance. Both ends should be terminated, as propagation is bi-directional. In the case of an RS-485 twisted pair cable, this termination is typically 120 Ohms.

3.5 DIP Switches

DIP Switch Functions

Switch	Function
1–7	Modbus Node ID See *Modbus Node ID Setting, p. 8*
8	Module specific settings.
9	
0	Baud rate: OFF = 9600, ON = programmed See *Communication Settings, p. 9*

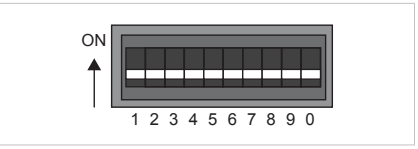


Fig. 3 DIP switches

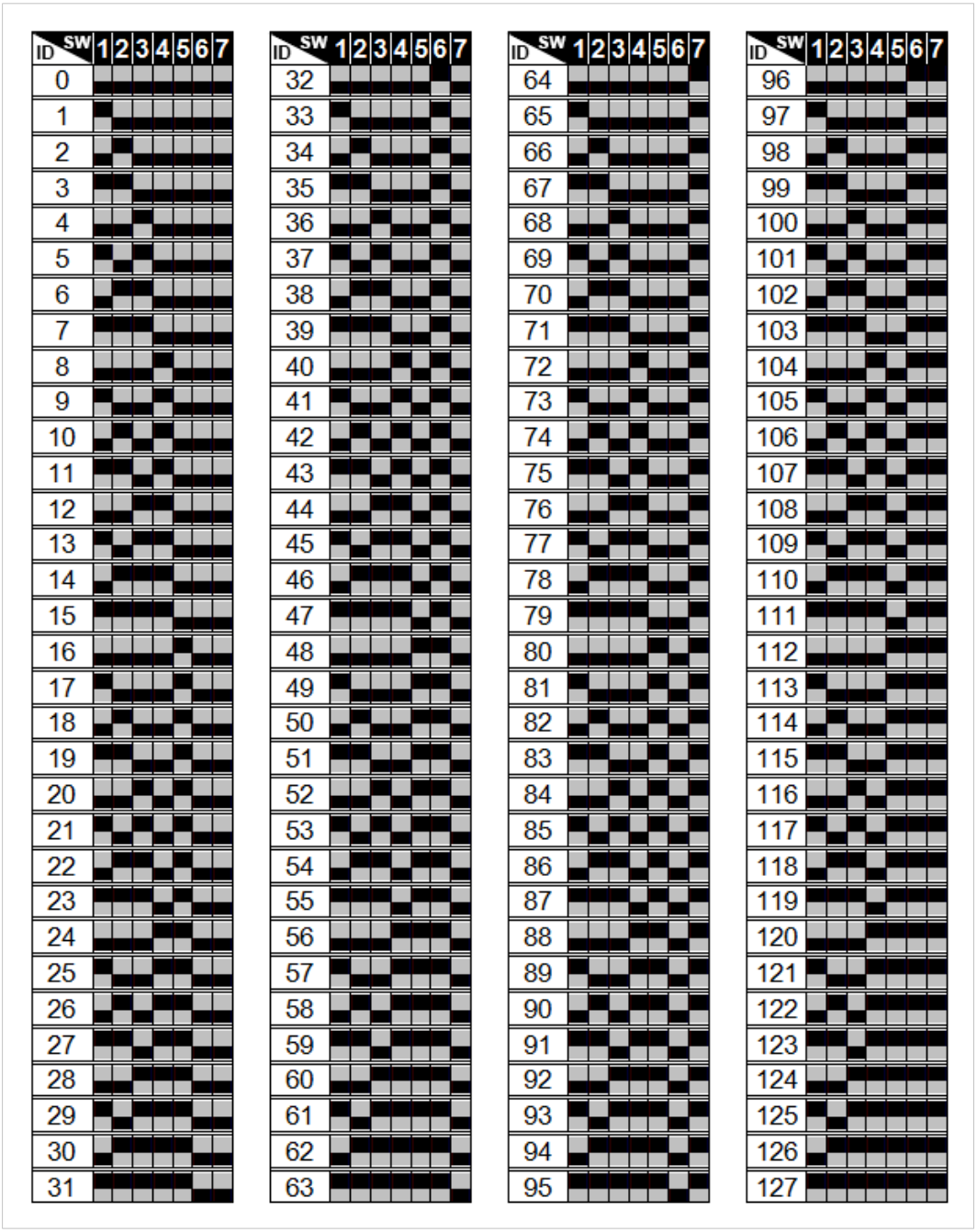
The status of the DIP switches is stored in register 30100.

MSB						DIP Switch Status Register									LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30100
—	—	—	—	—	—	0	9	8	7	6	5	4	3	2	1	
						DIP Switches										

3.6 Modbus Node ID Setting

Switches 1 to 7 are used to set the Modbus Node ID as shown in this table.

All modules will respond to a default Node ID of 254.



ID \ SW	1	2	3	4	5	6	7
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Fig. 4 Node ID DIP switch chart

3.7 Communication Settings

The data in the modules is stored in 16-bit registers. These registers are accessed over the network using the Modbus RTU communication protocol.

DIP Switch 0 setting	OFF (Default)	ON (Programmed Baud Setting)
Baud rate	9600	2400, 4800, 9600, 19200, 38400, 57600, 115200
Data bits	8	8
Parity	None	None, Even, Odd
Stop bits	1	1, 2

3.7.1 Communication Settings Registers

Modbus Address	Register Name	Low Limit	High Limit	Ac-cess	Comments
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,11520
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	65535	R/W	(x10ms)

The baud rate value is programmed directly into the baud rate register. The only exception is the 115200 baud rate, where the value 11520 is used.

The reply delay is a time delay between the Modbus message being received to the reply being sent. In some applications where a modem or radio is used in the RS-485 network, it may be necessary to add a reply delay due to turnaround delays in the equipment.

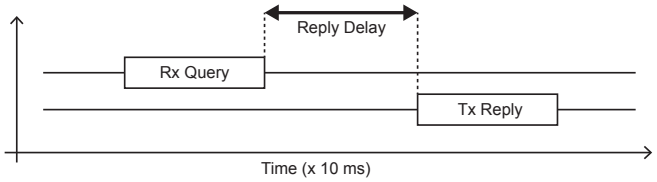

Fig. 5 Reply delay

*Reply delay works only when DIP switch 0 is set to **ON**.*

3.7.2 Supported Modbus Functions

Function Code	Modbus Function	Comment
1	Read Coil Status	Digital inputs/outputs
2	Read Input Status	Digital inputs/outputs
3	Read Holding Registers	Analog inputs/outputs
4	Read Input Registers	Analog inputs/outputs
5	Write Single Coil	Digital outputs
6	Write Single Register	Analog outputs
15	Write Multiple Coils	Digital outputs
16	Write Multiple Registers	Analog outputs

The Modbus message length must be limited to 100 consecutive read or write registers. If more registers are required, a new poll group must be added.

4 IOX-4RO – Relay Outputs

4.1 Description

The IOX-4RO module has 4 normally open/closed relay outputs. This module may be used for a higher drive capability, or when isolation between outputs is required.

When switch 9 is OFF, the module is configured as a Modbus slave and the outputs are written to by the Modbus master (PC/PLC/HMI). Each output on the module can be individually switched ON or OFF, or all outputs can be set up at the same time by writing a single number to the output register that represents the status of all outputs.

An output watchdog timer can be configured to switch off all outputs if there has been no communication with the module for up to 255 seconds. A value of 0 seconds will disable this timer and the outputs will remain in the last programmed state.

4.2 Technical Specifications

Power supply	Logic supply voltage	24 VDC
	Logic supply current	42 mA
Relay outputs	Output points	4
	Maximum current	0.5 A @ 220 VAC / 1 A @ 28 VDC
	Isolation	1000 Vrms between field and logic 1000 Vrms between outputs
Temperature	Operating temperature.	-10 °C to + 50 °C
	Storage temperature	-40 °C to + 85 °C
Connectors	Logic power and comms.	4-pin connector on underside of unit
	Outputs	18-way screw connector on front

4.3 Status Indicators

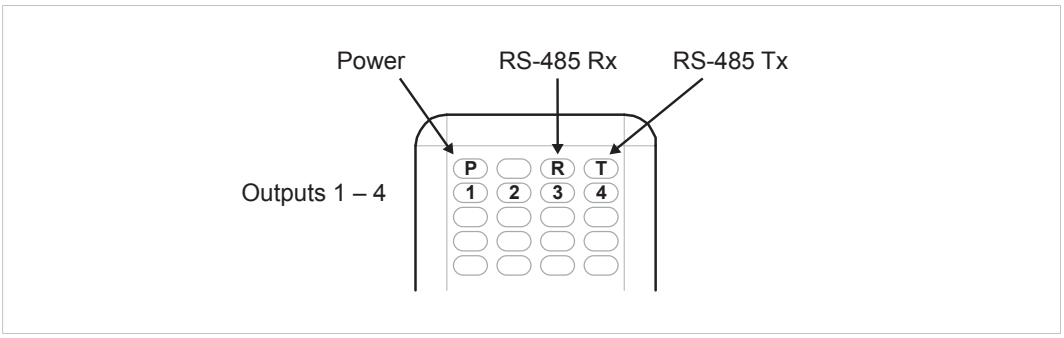

Fig. 6 IOX-4RO Status Indicators

Power	Indicates that the CPU is running.
RS-485 Rx	Flashes to indicate that the unit has received a valid Modbus message.
RS-485 Tx	Flashes to indicate that the unit has sent a Modbus message.
Outputs 1–4	OFF when the output is off, ON when the output is on.

4.4 Wiring

> *Do not reverse the power/communications connections as this may damage the unit.*

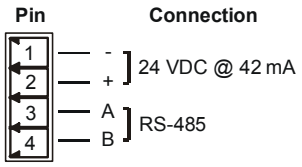

Fig. 7 IOX-4RO power and RS-485 wiring

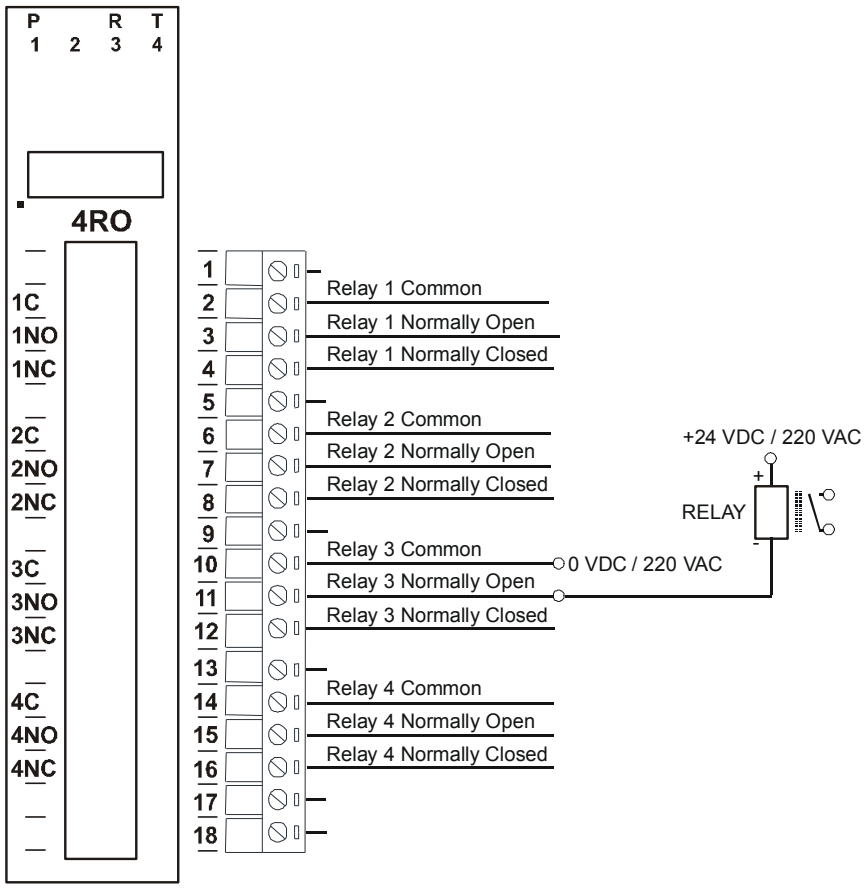

Fig. 8 IOX-4RO relay wiring example

4.5 DIP Switch Settings

Switch	Function	Description
1–7	NODE ID	Modbus Node ID — See *Modbus Node ID Setting, p. 8*
8	-	Not used
9	MODE	Slave (OFF)
0	BAUD RATE	OFF = 9600, ON = programmed. See *Communication Settings, p. 9*.

4.6 Data Registers

MODULE TYPE = 113

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
00001	Relay Output 1	0	1	R/W	Status of Digital Outputs.
00002	Relay Output 2	0	1	R/W	
00003	Relay Output 3	0	1	R/W	
00004	Relay Output 4	0	1	R/W	
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low byte = 113
40002	Digital Outputs	N/A	N/A	R/W	Digital Outputs in bits. 4(msb) - 1(lsb).
30100	DIP Switch	0	65535	R	Status of DIP switch on front panel
40101	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1–255 = enabled.
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600,19200, 38400, 57600, 115200 (115200 is entered as 11520)
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	65535	R/W	0 = Disable, >0 = Enable (x10 ms)

4.6.1 Relay Output Register

The relay outputs can be read/written in a single register as follows:

MSB							IOX-4RO Relay Outputs								LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	40002
—	—	—	—	—	—	—	—	—	—	—	—	4	3	2	1	
Relay Output Number																

4.6.2 Output Watchdog Timer

The watchdog timer is used to switch off all outputs in the event of a communications failure. When register 40101 is set to zero, the watchdog timer is disabled.

5 IOX-6RTD – RTD Inputs

5.1 Description

The IOX-6RTD is a 6 RTD input module that can accommodate 2 or 3-wire RTD sensors. The RTD inputs are isolated from the logic.

The RTD resistance is read by the module circuitry, linearised and converted to degrees Celsius. No ranging is required, as the module covers the full range of the RTD, as indicated in the RTD table. The value read from the Modbus register is the actual temperature with 0.1 °C resolution. i.e., a value of 3451 corresponds to a temperature of 345.1 °C.

The RTD type is set up by writing a value to the RTD Type register. The value is obtained from the table below. For example, to select PT100 RTD, the value "1" must be written to the RTD Type register. All 6 RTD inputs adopt the same RTD type.

DIP switch 9 is used to select upscale or downscale burnout for break detection. A value of 32768 is used to indicate upscale burnout and a value of -32767 indicates downscale burnout.

> **!** *As there is no inter-channel isolation, isolated RTD:s must be used in order to prevent ground loops and read errors.*

5.2 Technical Specifications

Power supply	Logic supply voltage		12–24 VDC	
	Logic supply current		87 mA @ 12 V / 45 mA @ 24 V	
RTD inputs	Input points		6	
	RTD configuration		2- or 3-wire	
	Resolution		0.1 °C	
	Drift		100 ppm/°C typical	
	Line resistance effect		< 0.1 °C balanced	
	Max. line resistance		100 Ohms	
	Isolation		1500 Vrms between field and logic	
RTD type	**Number**	**Type**	**Range**	**Accuracy**
	1	Pt100	-200 to +850 °C	±0.3 °C IEC 751:1983
	2	Ni120	-80 to +320 °C	±0.3 °C
	3	Pt1000	-200 to +850 °C	±0.3 °C
	4	Ni1000 (DIN)	-200 to +850 °C	±0.3 °C
	5	Ni1000 (Landis+Gyr)	-200 to +850 °C	±0.3 °C
	6	Ohms	10–400 Ω	±0.05 %
	7	Ohms	100–4000 Ω	±0.05 %
Temperature	Operating temperature		-10 °C to + 50 °C	
	Storage temperature		-40 °C to + 85 °C	
Connectors	Logic power and comms.		4-pin connector on underside of unit	
	Outputs		18-way screw connector on front	

5.3 Wiring

> ! *Do not reverse the power/communications connections as this may damage the unit.*

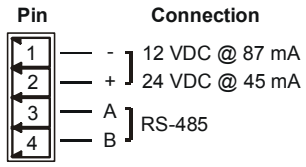

Fig. 9 IOX-6RTD power and RS-485 wiring

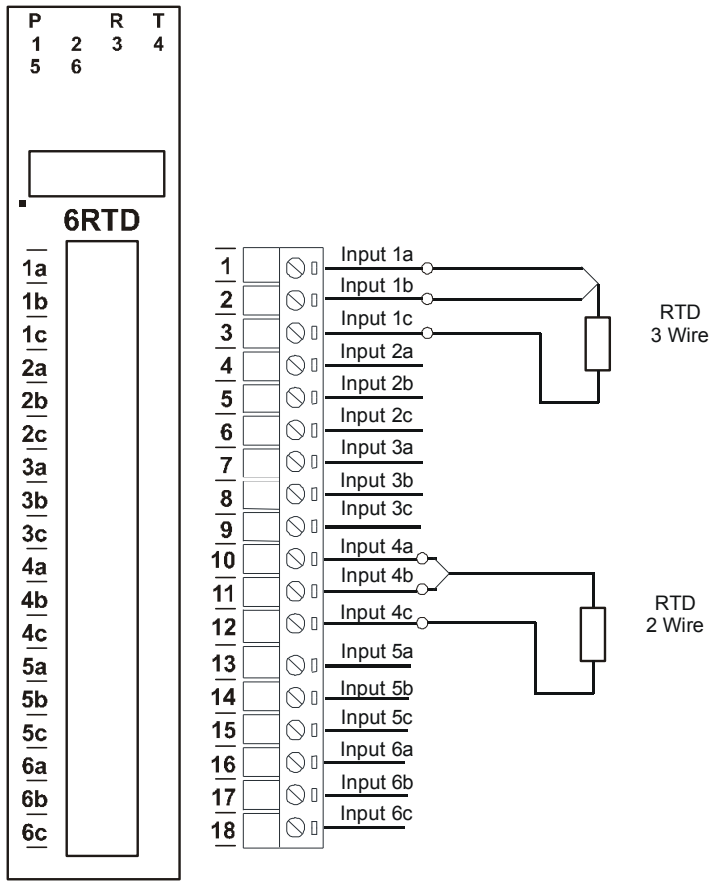

Fig. 10 IOX-6RTD input wiring example

5.4 Status Indicators

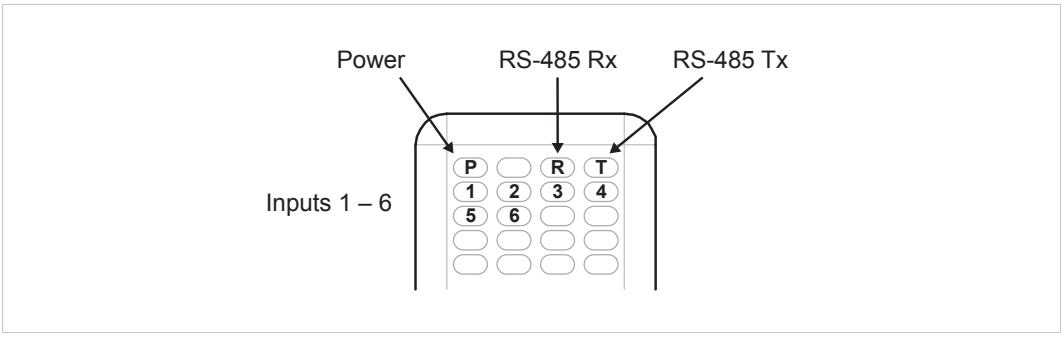

Fig. 11 IOX-6RTD Status Indicators

Power	Indicates that the CPU is running.
RS-485 Rx	Flashes to indicate that the unit has received a valid Modbus message.
RS-485 Tx	Flashes to indicate that the unit has sent a Modbus message.
Inputs 1–6	ON when the RTD is open circuit, OFF when the RTD is connected.

5.5 DIP Switch Settings

Switch	Function	Description
1–7	NODE ID	Modbus Node ID — See *Modbus Node ID Setting, p. 8*
8	-	Not used
9	BREAK	RTD break. When switched OFF, the RTD value will be -32767 when the RTD is faulty. When set to ON, the RTD value will be 32768.
0	BAUD RATE	OFF = 9600, ON = programmed. See *Communication Settings, p. 9*.

5.6 Data Registers

MODULE TYPE = 109

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low byte = 109
30002	RTD Input 1			R	For ranges,see *Technical Specifications, p. 13*.
30003	RTD Input 2			R	
30004	RTD Input 3			R	
30005	RTD Input 4			R	
30006	RTD Input 5			R	
30007	RTD Input 6			R	
30008	Input Status	0	65535	R	bit1 = 0 (OK) bit1 = 1 (Error or open circuit)
30100	DIP Switch	0	65535	R	Status of DIP switch on front panel
40101	RTD Type	1	7	R/W	See *Technical Specifications, p. 13*.
40102	Line Frequency	50	60	R/W	Line frequency
40103	Units Type	1	2	R/W	1 = °C, 2 = °F
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	65535	R/W	0 = Disable, >0 = Enable. (x10 ms)

5.6.1 RTD Input Status

There is one status bit associated with each RTD input. These bits are used to indicate if the input is open circuit or over range, and if so the error bit will be set.

Bit 1 – Error	Bit 2 – Not used	Condition	Status LED
0	0	Input working OK	LED OFF
1	0	Open circuit/Over range	LED ON

DIP Switch Status Register (30100)

MSB					IOX-6RTD Input Status										LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30008
					RTD6 Error		RTD5Error		RTD4 Error		RTD3 Error		RTD2 Error		RTD1 Error	

6 IOX-8DIO – Digital Inputs/Outputs

6.1 Description

The IOX-8DIO module has 8 digital inputs and 8 digital outputs. The inputs are isolated from the logic by bi-directional opto-couplers. The common is connected internally to either the +V or -V field power supply terminals, using a jumper inside the housing.

The inputs have internal counters associated with them. These are 32-bit counters allowing a count value in the range 0-4294967295. This value can be cleared by writing a zero to the associated registers, or it can be preset to any other value using the same method.

> ! *The count values will be lost if power is disconnected.*

The format of the registers allows the status of the inputs to be read either as single bits, or all at once as a single register on the Modbus network.

The 8 digital outputs are of the type open collector (NPN). These may be used to drive lamps or external relays when more drive capability is required. The outputs are isolated from the logic and they share a common negative terminal.

When switch 9 is OFF, the module is configured as a Modbus slave and the outputs are written to by the Modbus master (PC/PLC/HMI). Each output on the module can be individually switched ON or OFF, or all outputs can be set up at the same time by writing a single number to the output register that represents the status of all outputs.

6.2 Technical Specifications

Power supply	Logic supply voltage	12–24 VDC
	Logic supply current	33 mA @ 12 V / 19 mA @ 24 V
	Field supply voltage	12–24 VDC
	Field supply current	6 mA @ 12 V / 6 mA | 24 V
Digital inputs	Input points	8
	Input voltage range	12–24 VDC
	Input current per input	5 mA @ 12 V / 11 mA @ 24 V
	Isolation	1500 Vrms between field and logic
Digital outputs	Output points	8
	Maximum voltage	36 VDC
	Maximum current	100 mA per output
	VCEon	1.1 V (max)
	Isolation	1500 Vrms between field and logic
Counters	Inputs	1 to 16
	Resolution	32 bits
	Frequency	1 KHz (max)
	Pulse width	500 µs (min)
Temperature	Operating temperature	-10 °C to + 50 °C
	Storage temperature	-40 °C to + 85 °C
Connectors	Logic power and comms.	4-pin connector on underside of unit
	Outputs	18-way screw connector on front

> ⓘ *Inputs 1 to 8 are used both as digital inputs and counter inputs.*

6.3 Wiring

> *Do not reverse the power/communications connections as this may damage the unit.*

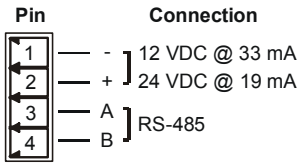

Fig. 12 IOX-8DIO power and RS-485 wiring

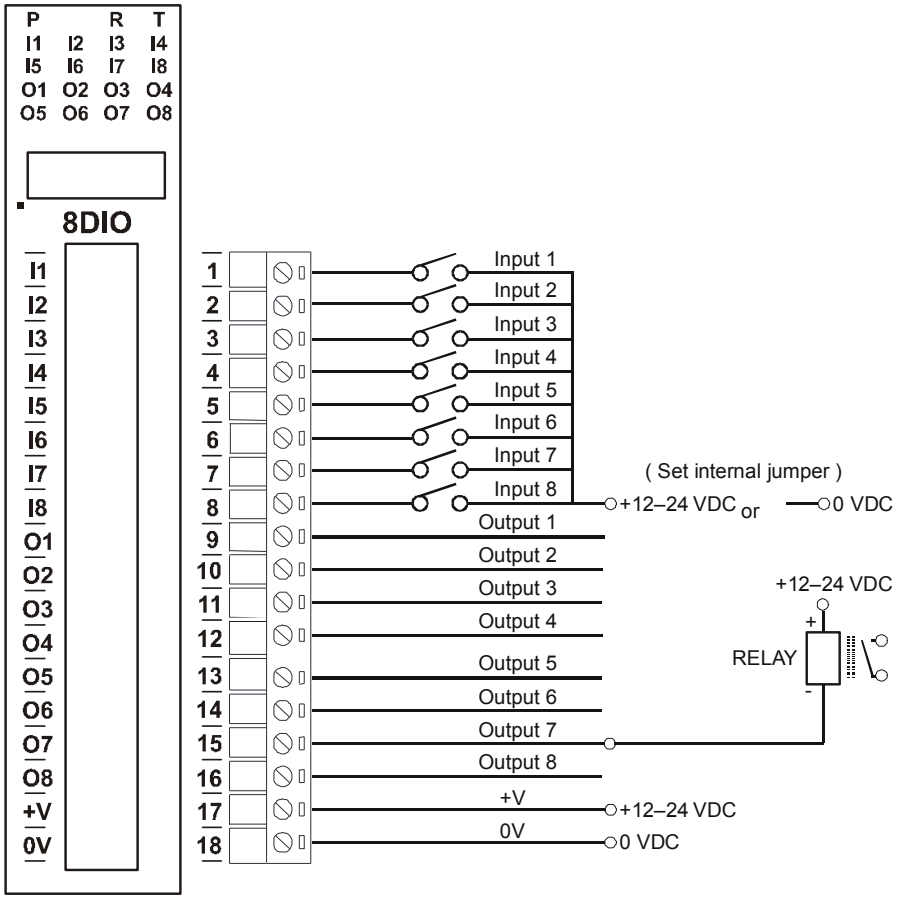

Fig. 13 IOX-8DIO input/output wiring example

6.4 Status Indicators

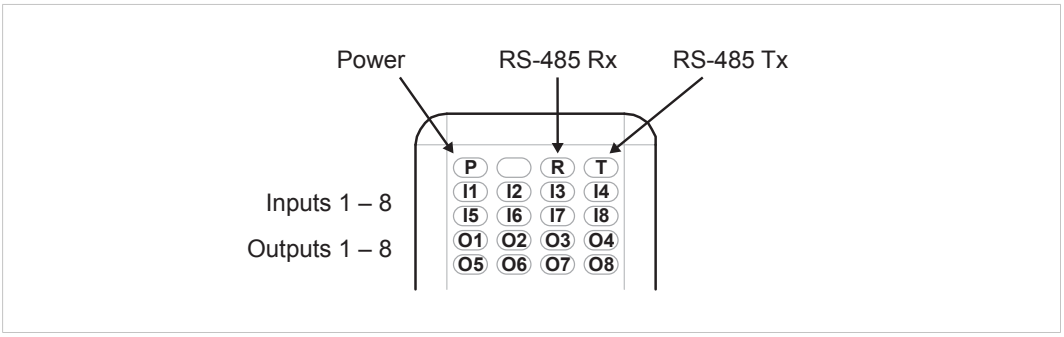

Fig. 14 IOX-8DIO Status Indicators

Power	Indicates that the CPU is running.
RS-485 Rx	Flashes to indicate that the unit has received a valid Modbus message.
RS-485 Tx	Flashes to indicate that the unit has sent a Modbus message.
Inputs 1–8	OFF when the input is off, ON when the input is on.
Outputs 1–8	OFF when the output is off, ON when the output is on.

6.5 DIP Switch Settings

Switch	Function	Description
1–7	NODE ID	Modbus Node ID — See *Modbus Node ID Setting, p. 8*
8	INVERT	ON = status of the inputs is inverted in the Modbus status register (30002)
9	MODE	OFF (Slave)
0	BAUD RATE	OFF = 9600, ON = programmed. See *Communication Settings, p. 9*.

6.6 Jumper Settings

The digital inputs can be configured as NPN or PNP type by changing the position of the jumper **LK1**.

LK1 jumper setting

Position	Function
NPN (default)	Digital inputs operated by switching to -V (0 V)
PNP	Digital inputs operated by switching to +V (+12 V to +24 V)

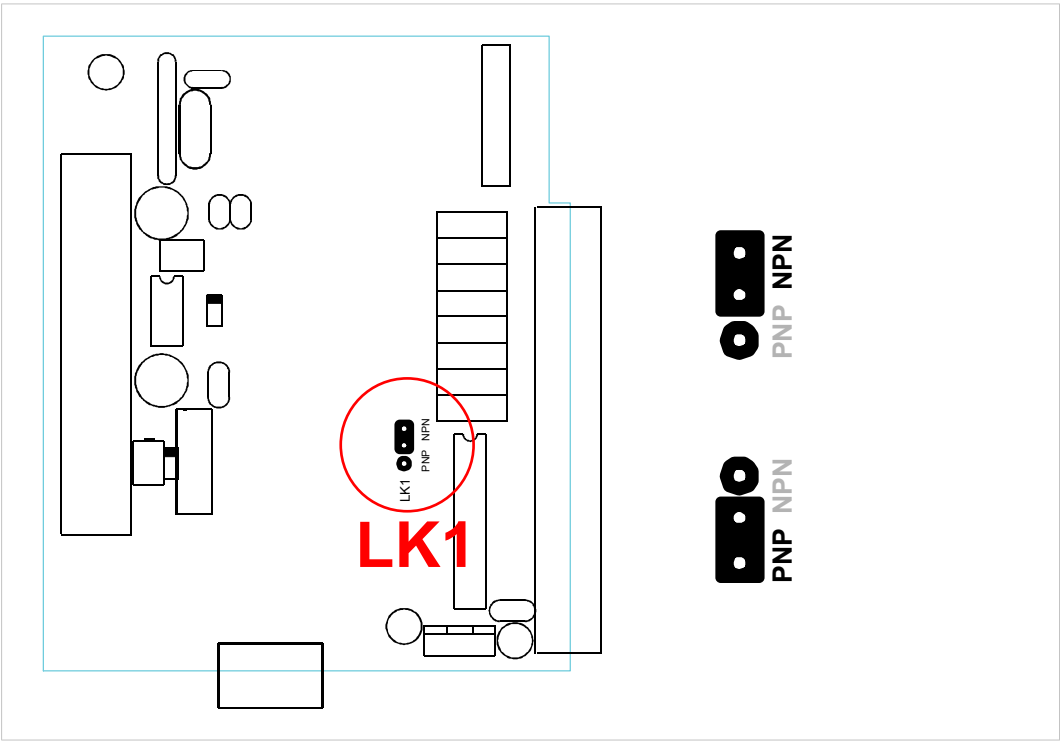

Fig. 15 LK1 jumper setting

6.7 Data Registers

MODULE TYPE = 102

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
10001	Digital Input 1	0	1	R	Status of digital inputs
10002	Digital Input 2	0	1	R	
10003	Digital Input 3	0	1	R	
10004	Digital Input 4	0	1	R	
10005	Digital Input 5	0	1	R	
10006	Digital Input 6	0	1	R	
10007	Digital Input 7	0	1	R	
10008	Digital Input 8	0	1	R	
00017	Digital Output 1	0	1	R/W	Status of digital outputs
00018	Digital Output 2	0	1	R/W	
00019	Digital Output 3	0	1	R/W	
00020	Digital Output 4	0	1	R/W	
00021	Digital Output 5	0	1	R/W	
00022	Digital Output 6	0	1	R/W	
00023	Digital Output 7	0	1	R/W	
00024	Digital Output 8	0	1	R/W	
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low byte = 102
30002	Digital Inputs	N/A	N/A	R	Digital inputs in lower 8 bits. 8-1.
40003	Digital Outputs	N/A	N/A	R/W	Digital outputs in lower 8 bits. 8-1.
40004	Counter 1 MSB	0	65535	R/W	Counter MSB and LSB combine to give a 32-bit counter with range 0-4294967295.
40005	Counter 1 LSB	0	65535	R/W	
40006	Counter 2 MSB	0	65535	R/W	
40007	Counter 2 LSB	0	65535	R/W	
40008	Counter 3 MSB	0	65535	R/W	
40009	Counter 3 LSB	0	65535	R/W	
40010	Counter 4 LSB	0	65535	R/W	
40011	Counter 4 LSB	0	65535	R/W	
40012	Counter 5 MSB	0	65535	R/W	
40013	Counter 5 LSB	0	65535	R/W	
40014	Counter 6 MSB	0	65535	R/W	
40015	Counter 6 LSB	0	65535	R/W	
40016	Counter 7 MSB	0	65535	R/W	
40017	Counter 7 LSB	0	65535	R/W	
40018	Counter 8 MSB	0	65535	R/W	
40019	Counter 8 LSB	0	65535	R/W	
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1–255 = enabled.
40105	Counter Mode	0	2	R/W	0 = Disable, 1 = Up Counting, 2 = Up/ Down Count
40106	Input Filter	0	65535	R/W	0 = Disable, >0 = Enable. (x10 ms)
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	65535	R/W	0 = Disable, >0 = Enable. (x10 ms)

6.7.1 Digital Input Register

The digital inputs can be read in a single register as follows:

MSB								IOX-8DIO Digital Inputs							LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30002
—	—	—	—	—	—	—	—	8	7	6	5	4	3	2	1	
								Digital Input Number								

6.7.2 Digital Output Register

The digital outputs can be read/written in a single register as follows:

MSB								IOX-8DIO Digital Outputs							LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	40003
—	—	—	—	—	—	—	—	8	7	6	5	4	3	2	1	
								Digital Output Number								

6.7.3 Counter Registers

Counters are stored in two 16-bit registers: the High Register and the Low Register. To get the actual 32-bit count value, the registers must be combined as follows:

Counter High Value	Register 40003
Counter Low Value	Register 40004
Counter Value	(Counter High Value x 65535) + Counter Low Value

6.7.4 Output Watchdog Timer

The watchdog timer is used to switch off all outputs in the event of a communications failure. When register 40101 is set to zero, the watchdog timer is disabled.

7 IOX-DAIO – Digital and Analog Inputs/Outputs

7.1 Description

The IOX-DAIO module is a multi-purpose combination of inputs and outputs. It can accommodate the following:

- 2- or 3-wire RTD sensors
- Current (0–20 mA) inputs
- Voltage (0–10 V) inputs
- Current (0–20 mA) output
- Voltage (0–10 V) output
- Digital inputs
- Digital outputs

7.1.1 RTD Inputs

The RTD resistance is read by the module circuitry, linearised and converted to degrees Celsius. No ranging is required, as the module covers the full range of the RTD, as indicated in the RTD table. The value read from the Modbus register is the actual temperature with 0.1 °C resolution. i.e., a value of 3451 corresponds to a temperature of 345.1 °C.

The RTD type is set up by writing a value to the RTD Type register. The value is obtained from the table below. For example, to select PT100 RTD, the value “1” must be written to the RTD Type register. All 6 RTD inputs adopt the same RTD type.

A value of -32767 indicates downscale burnout.

> **!** *As there is no inter-channel isolation, isolated RTD:s must be used in order to prevent ground loops and read errors.*

7.1.2 Analog Inputs

The Analog Inputs can be configured by internal jumpers as current inputs (0–20 mA), or as voltage inputs (0–10 V). An input within these ranges represents an output value range of 0–4095 (12 bits) in the corresponding Modbus register.

7.1.3 Analog Output

The single analog output can be configured by internal jumpers for a current output (0–20 mA), or a voltage output (0–10 V).

The resolution is 12 bits, so writing a value to the Modbus register of 0–4095 would give an output current of 0–20 mA. A value of 819 ± 1LSB will give a current output of 4 mA.

7.1.4 Digital Inputs

There are 4 digital inputs on the module. These share a common terminal and can be configured for common positive or common negative.

The inputs have counters associated with them, which operate in three modes:

Mode 0	All counters are disabled.
Mode 1	All counters are 32-bit counters allowing a count value 0–4294967295. The count value can be cleared by writing a zero to the associated registers, or they can be preset to any other value using the same method.
Mode 2	The inputs are connected as up/down counters. Input 1 will count counter 1 up, while input 2 counts counter 1 down.

> ! *The count values will be lost if power is disconnected.*

The format of the registers allows the status of the inputs to be read either as single bits, or all at once as a single register on the Modbus network.

7.1.5 Digital Outputs

The 2 digital outputs are of the type open collector (NPN). These may be used to drive lamps or external relays when more drive capability is required. The outputs are isolated from the logic and they share a common negative terminal.

The outputs are written to by a Modbus master device, such as a PC / PLC / HMI. Each output on the module can be individually switched ON or OFF, or all outputs can be set up at the same time by writing a single number to the output register that represents the status of all outputs.

An output watchdog timer can be configured to switch off all outputs if there has been no communication with the module for up to 255 seconds. A value of 0 seconds will disable this timer and the outputs will remain in the last programmed state.

7.2 Technical Specifications

Power supply	Logic supply voltage		12–24 VDC	
	Logic supply current		115 mA @ 12 V / 58 mA @ 24 V	
	Field supply voltage		24 VDC	
	Field supply current		25 mA	
RTD inputs	Input points		2	
	RTD configuration		2- or 3-wire	
	Resolution		0.1 °C	
	Drift		100 ppm/°C typical	
	Line resistance effect		< 0.1 °C balanced	
	Max. line resistance		100 Ω	
	Isolation		1500 Vrms between field and logic	
RTD type	**Number**	**Type**	**Range**	**Accuracy**
	1	Pt100	-200 to +850 °C	±0.3 °C IEC 751:1983
	2	Ni120	-80 to +320 °C	±0.3 °C
	3	Pt1000	-200 to +850 °C	±0.3 °C
	4	Ni1000 (DIN)	-200 to +850 °C	±0.3 °C
	5	Ni1000 (Landis+Gyr)	-200 to +850 °C	±0.3 °C
	6	Ohms	10–400 Ω	±0.05 %
	7	Ohms	100–4000 Ω	±0.05 %
Current inputs	Input points		2	
	Input current		0–20 mA	
	Input resistance		250 Ω	
	Input type	**Range**	**Resolution**	
	1	0–4095	12 bits	
	2	0–20 mA	1 µA	
	3	+/- 20 mA	1 µA	
	Drift		100 ppm/°C	
	Accuracy		0.2 % of span	
	Isolation		1000 Vrms between field and logic	
Voltage inputs	Input points		2	
	Input voltage		0–1 VDC or 0–10 VDC	
	Input resistance		190 kΩ	
	Input type	**Range**	**Resolution**	
	4	0–4095	12 bits	
	5	0–10 V	1 mV	
	6	+/-10 V	1 mV	
	7	0–1 V	0.1 mV	
	8	+/-1 V	0.1 mV	
	Drift		100 ppm/°C	
	Accuracy		0.2 % of span	
	Isolation		1000 Vrms between field and logic	
Current outputs	Output points		1	
	Output current		0–20 mA	
	Output type	**Range**	**Resolution**	
	1	0–4095	12 bits	
	Drift		100 ppm/°C	
	Accuracy		0.05 % of span	
	Compliance		500 Ω max. @ 12 VDC 1000 Ω max. @ 24 VDC	

Voltage outputs	Output points		2
	Output voltage		0 (2)–10 V
	Output type	**Range**	**Resolution**
	2	0–4095	12 bits
	Drift		100 ppm/°C
	Accuracy		0.05 % of span
	Compliance		200 Ω min. load
Digital inputs	Input points		4
	Input voltage range		10–26 VDC
	Input current per input		4 mA @ 12 V / 8 mA @ 24 V
	Isolation		1500 Vrms between field and logic
Digital outputs	Output points		2
	Maximum voltage		36 VDC
	Maximum current		100 mA per output
	VCEon		1.1 V (max)
	Isolation		1500 Vrms between field and logic
Counters	Inputs		1 to 4
	Resolution		32 bits
	Frequency		50 Hz (max)
	Pulse width		20 ms (min)
Temperature	Operating temperature		-10 °C to + 50 °C
	Storage temperature		-40 °C to + 85 °C
Connectors	Logic power and comms.		4-pin connector on underside of unit
	Outputs		18-way screw connector on front

7.3 Status Indicators

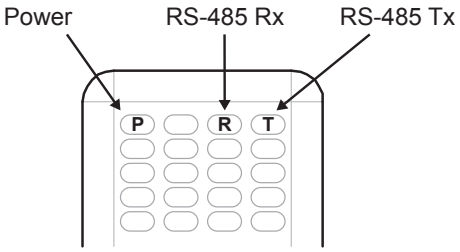

Fig. 16 IOX-DAIO Status Indicators

Power	Indicates that the CPU is running.
RS-485 Rx	Flashes to indicate that the unit has received a valid Modbus message.
RS-485 Tx	Flashes to indicate that the unit has sent a Modbus message.

Input/Output status LEDs are not available in the IOX-DAIO module.

7.4 Wiring

> *Do not reverse the power/communications connections as this may damage the unit.*

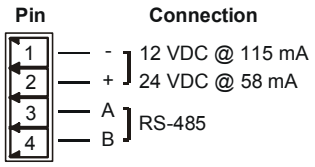

Fig. 17 IOX-DAIO power and RS-485 wiring

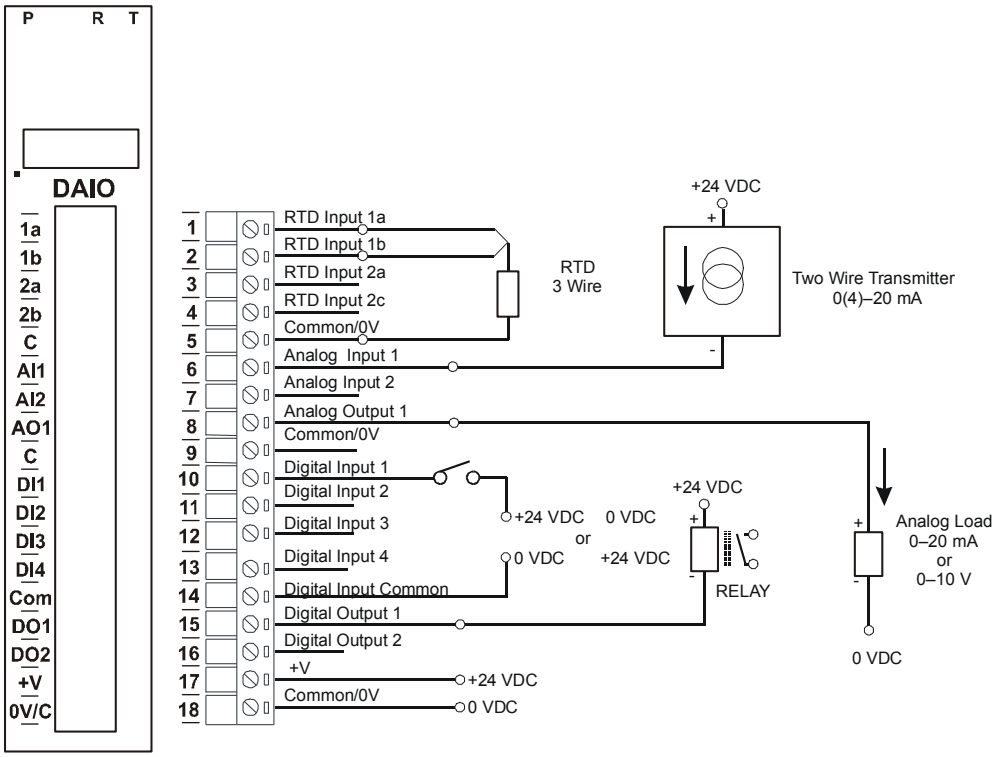

Fig. 18 IOX-DAIO input/output wiring example

7.5 DIP Switch Settings

Switch	Function	Description
1–7	NODE ID	Modbus Node ID — See *Modbus Node ID Setting, p. 8*
8	—	Not used
9	—	Not used
0	BAUD RATE	OFF = 9600, ON = programmed. See *Communication Settings, p. 9*.

7.6 Jumper Settings

The two analog inputs and single analog output can be configured for current or voltage by changing the position of jumpers J7–J11.

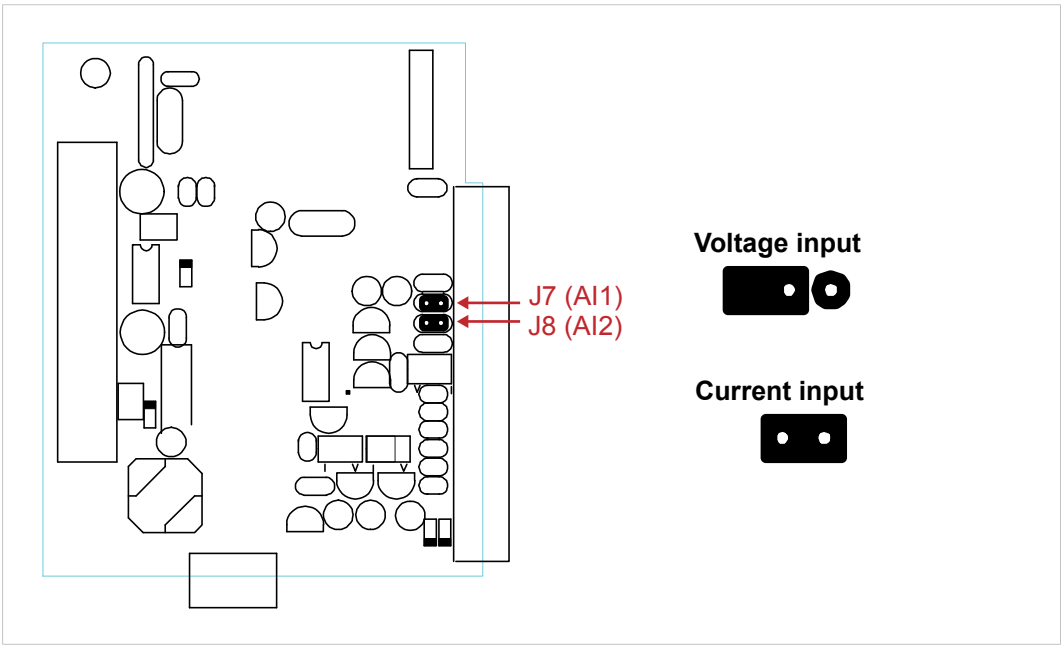

Fig. 19 Analog inputs jumper setting

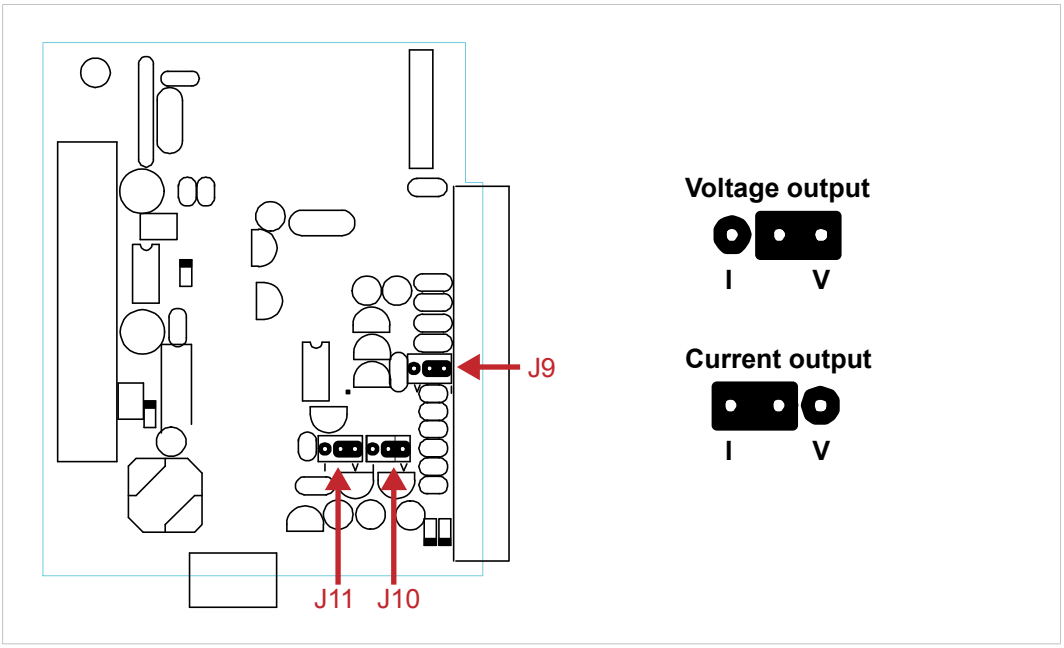

Fig. 20 Analog output jumper setting

7.7 Data Registers

MODULE TYPE = 112

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
10001	Digital Input 1	0	1	R	Status of Digital Inputs
10002	Digital Input 2	0	1	R	
10003	Digital Input 3	0	1	R	
10004	Digital Input 4	0	1	R	
00017	Digital Output 1	0	1	R/W	Status of Digital Outputs
00018	Digital Output 2	0	1	R/W	
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low byte = 102
30002	Digital Inputs	N/A	N/A	R	Digital inputs in lower 8 bits. 8-1.
40003	Digital Outputs	N/A	N/A	R/W	Digital outputs in lower 8 bits. 8-1.
40004	RTD Input 1	–	–	R	For ranges, see *Technical Specifications, p. 25*.
40005	RTD Input 2	–	–	R	
40006	Analog Input 1	0	4095	R	
40007	Analog Input 2	0	4095	R	
40008	Analog Output	0	4095	R/W	
40009	Counter 1 MSB	0	65535	R/W	Counter MSB and LSB combine to give a 32-bit counter with range 0-4294967295.
40010	Counter 1 LSB	0	65535	R/W	
40011	Counter 2 MSB	0	65535	R/W	
40012	Counter 2 LSB	0	65535	R/W	
40013	Counter 3 MSB	0	65535	R/W	
40014	Counter 3 LSB	0	65535	R/W	
40015	Counter 4 MSB	0	65535	R/W	
40016	Counter 4 LSB	0	65535	R/W	
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1–255 = enabled.
40102	Counter Mode	0	2	R/W	0 = Disable, 1 = Up Counting, 2 = Up/Down Count
40103	Input Filter	0	65535	R/W	0 = Disable, >0 = Enable. (x10 ms)
40104	RTD 1 Type	1	7	R/W	See *Technical Specifications, p. 25*
40105	RTD 2 Type	1	7	R/W	
40106	AI 1 Type	1	8	R/W	
40107	AI 2 Type	1	8	R/W	
40108	AO Type	1	2	R/W	1 = 0–20 mA, 2 = 0–10 V
40109	Line Frequency	50	60	R/W	Line frequency
40110	Units Type	1	2	R/W	1 = °C, 2 = °F
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	65535	R/W	0 = Disable, >0 = Enable. (x10 ms)

8 IOX-8AIV – Analog Voltage Inputs

8.1 Description

The IOX-8AIV module has 8 analog voltage inputs. The inputs are isolated from the logic and share a common negative terminal.

An input voltage of 0–10 V corresponds to an output of 0–4095 (12 bits) in the Modbus register. If the OFFSET switch is switched on, 0–4095 represents 2–10 V.

If the jumper on the analog board is removed, the input range will be 0–5 V, or 1–5 V if the OFFSET switch is on.

8.2 Technical Specifications

Power supply	Logic supply voltage	12–24 VDC
	Logic supply current	27 mA @ 12 V / 16 mA @ 24 V
	Field supply voltage	12–24 VDC
	Field supply current	8 mA @ 12 V / 15 mA @ 24 V
Voltage inputs	Input points	8
	Input voltage	0(2)–10 VDC or 0(1)–5 VDC
	Input resistance	20 kΩ
	Resolution	12 bits
	Drift	50 ppm/°C
	Accuracy	0.2 % of span
	Isolation	1500 Vrms between field and logic
Temperature	Operating temperature	-10 °C to + 50 °C
	Storage temperature	-40 °C to + 85 °C
Connectors	Logic power and comms.	4-pin connector on underside of unit
	Outputs	18-way screw connector on front

8.3 Status Indicators

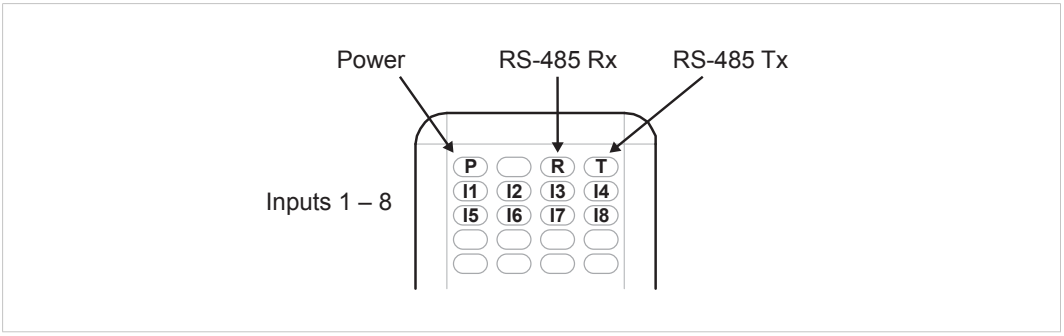

Fig. 21 IOX-8AIV Status Indicators

Power	Indicates that the CPU is running.
RS-485 Rx	Flashes to indicate that the unit has received a valid Modbus message.
RS-485 Tx	Flashes to indicate that the unit has sent a Modbus message.
Inputs 1–8	OFF when the input is off, ON when the input is on.

8.4 Wiring

> ! *Do not reverse the power/communications connections as this may damage the unit.*

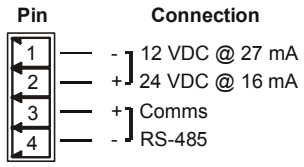

Fig. 22 IOX-8AIV power and RS-485 wiring

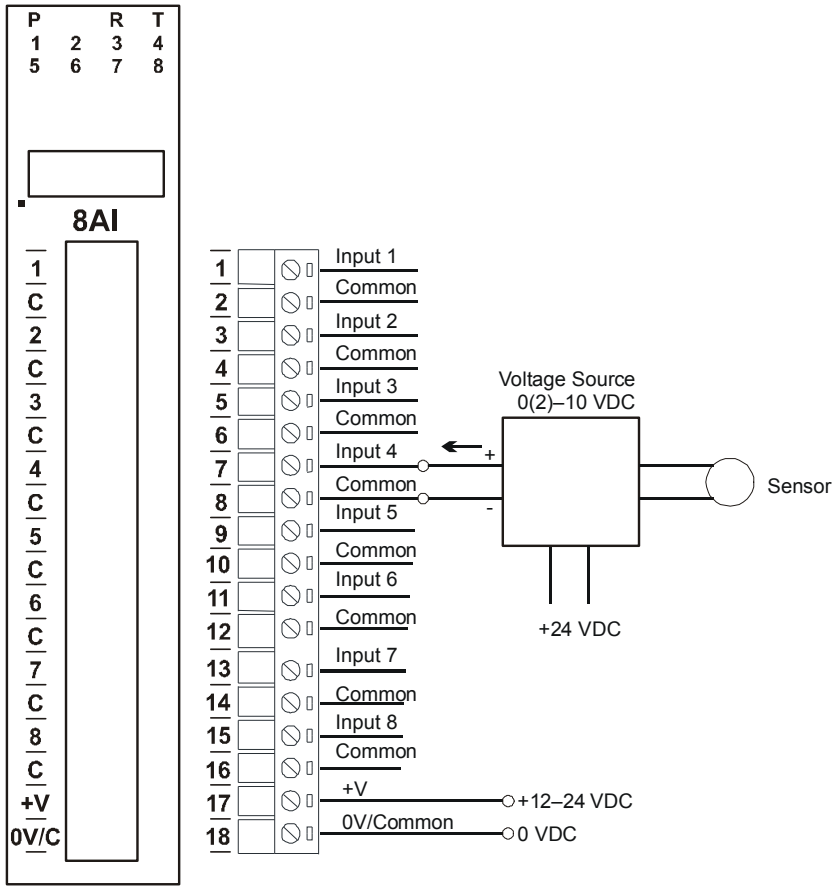

Fig. 23 IOX-8AIV input wiring example

8.5 DIP Switch Settings

Switch	Function	Description
1–7	NODE ID	Modbus Node ID — See *Modbus Node ID Setting, p. 8*
8	—	Not used
9	OFFSET	ON = inputs are scaled to accept a 2 V offset.
0	BAUD RATE	OFF = 9600, ON = programmed. See *Communication Settings, p. 9*.

8.6 Data Registers

MODULE TYPE = 104

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low byte = 102
30002	Analog Input 1	0	4095	R	Analog inputs in lower 12 bits.
30003	Analog Input 2	0	4095	R	
30004	Analog Input 3	0	4095	R	
30005	Analog Input 4	0	4095	R	
30006	Analog Input 5	0	4095	R	
30007	Analog Input 6	0	4095	R	
30008	Analog Input 7	0	4095	R	
30009	Analog Input 8	0	4095	R	
30010	Input Status	0	65535	R	bit 2 = 0 (open circuit or <2) bit 2 = 1 (over range) bit 1 = 0 (OK) bit 1 = 1 (error)
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	65535	R/W	0 = Disable, >0 = Enable. (x10 ms)

8.6.1 Analog Input Registers

The analog inputs are read as a 12 bit value in the registers as follows:

MSB				IOX-8AIV Analog Inputs											LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	300xx
—	—	—	—	x	x	x	x	x	x	x	x	x	x	x	x	
				Analog Input: 12 bit value (0–4095)												

8.6.2 Analog Input Status

There are two status bits associated with each analog input. These bits are used to indicate if the input is zero or open circuit, in the working range 0–4095, or over range. If the input is open circuit or over range, the error bit will be set. When the error bit is set, the range bit is zero if the input is open circuit, and is set if the input is over range.

Bit 1 – Error	Bit 2 – Range	Condition	Status LED
0	Any	Input working OK	Off
1	0	Open circuit or zero	On
1	1	Over range	Flashing

MSB					IOX-8AIV Analog Input Status										LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30010
AI 8 Range	AI 8 Error	AI 7 Range	AI 7 Error	AI 6 Range	AI 6 Error	AI 5 Range	AI 5 Error	AI 4 Range	AI 4 Error	AI 3 Range	AI 3 Error	AI 2 Range	AI 2 Error	AI 1 Range	AI 1 Error	

9 IOX-8AIIS – Isolated Analog Current Inputs

9.1 Description

The 8 current inputs in the IOX-8AIIS module are fully isolated from input to logic, and between inputs. This module is ideal for monitoring current loops that are isolated from each other and which cannot be connected to a common point of reference.

An input current of 0–20 mA corresponds to an output of 0–4095 (12 bits) in the Modbus register. If the OFFSET switch is switched on, 0–4095 represents 4–20 mA.

The module can also be configured for a 0–20 mA input range or a +/- 20 mA input.

9.2 Technical Specifications

Power supply	Logic supply voltage	12–24 VDC	
	Logic supply current	58 mA @ 12 V / 31 mA @ 24 V	
Current inputs	Input points	8	
	Input current	0(4)–20 20 mA	
	Input type	**Range**	**Resolution**
	1	0–4095	12 bits
	2	0–20 mA	1 µA
	3	+/- 20 mA	1 µA
	Drift	100 ppm/°C	
	Isolation	1000 Vrms between field and logic 350 V peak between each input	
Temperature	Operating temperature	-10 °C to + 50 °C	
	Storage temperature	-40 °C to + 85 °C	
Connectors	Logic power and comms.	4-pin connector on underside of unit	
	Outputs	18-way screw connector on front	

9.3 Status Indicators

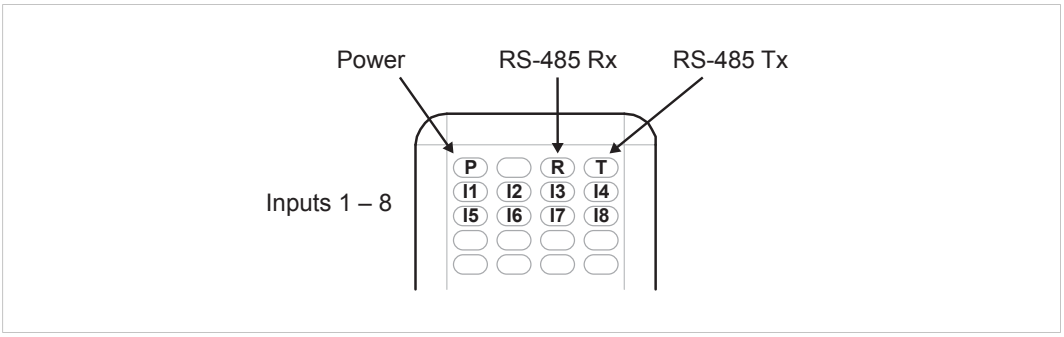

Fig. 24 IOX-8AIIS Status Indicators

Power	Indicates that the CPU is running.
RS-485 Rx	Flashes to indicate that the unit has received a valid Modbus message.
RS-485 Tx	Flashes to indicate that the unit has sent a Modbus message.
Inputs 1–8	OFF when the input is off, ON when the input is on.

9.4 Wiring

> ! *Do not reverse the power/communications connections as this may damage the unit.*

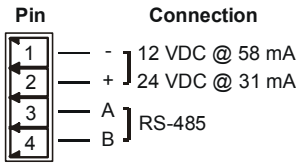

Fig. 25 IOX-8AIIS power and RS-485 wiring

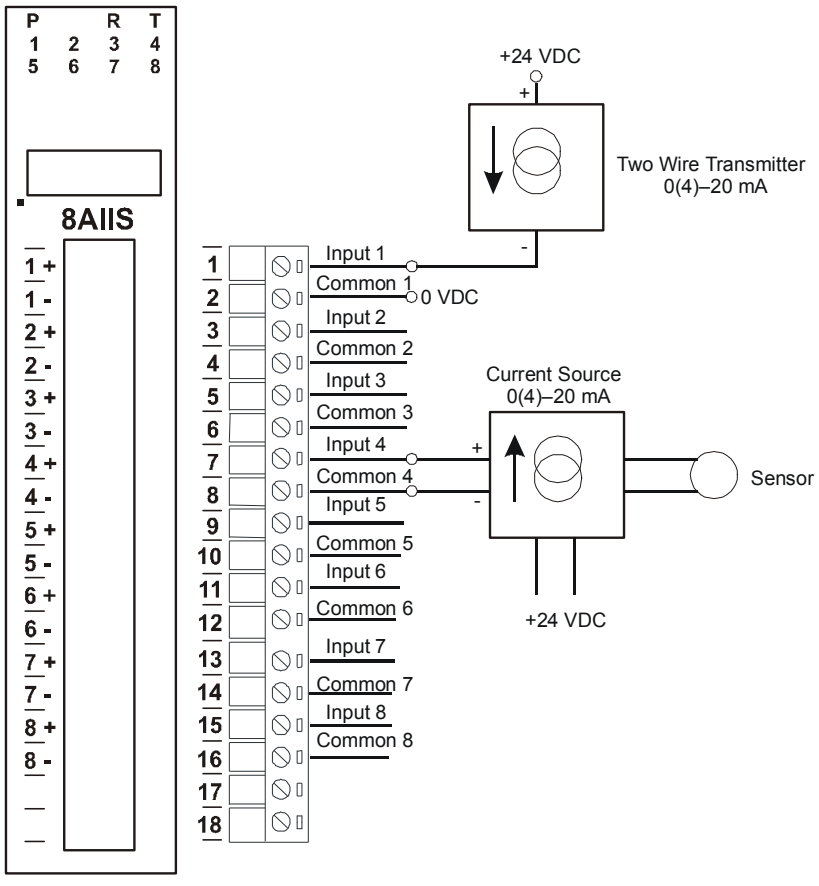

Fig. 26 IOX-8AIIS input wiring example

9.5 DIP Switch Settings

Switch	Function	Description
1–7	NODE ID	Modbus Node ID — See *Modbus Node ID Setting, p. 8*
8	OFFSET	ON = inputs are scaled to accept a 4 mA offset.
9	OUT OF RANGE	Out of range is given when the input is too negative or too positive. OFF = the analog value will be loaded with -32767 when out of range. ON = the analog value will be loaded with 32768 when out of range.
0	BAUD RATE	OFF = 9600, ON = programmed. See *Communication Settings, p. 9*.

9.6 Data Registers

MODULE TYPE = 104

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low byte = 102
30002	Analog Input 1	0	4095	R	Analog inputs in lower 12 bits.
30003	Analog Input 2	0	4095	R	
30004	Analog Input 3	0	4095	R	
30005	Analog Input 4	0	4095	R	
30006	Analog Input 5	0	4095	R	
30007	Analog Input 6	0	4095	R	
30008	Analog Input 7	0	4095	R	
30009	Analog Input 8	0	4095	R	
30010	Input Status	0	65535	R	bit 2 = 0 (open circuit or <2) bit 2 = 1 (over range) bit 1 = 0 (OK) bit 1 = 1 (error)
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Analog Input Type	0	5	R/W	See *Technical Specifications, p. 34*.
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	65535	R/W	0 = Disable, >0 = Enable. (x10 ms)

9.6.1 Analog Input Registers

The analog inputs are read as a 12 bit value in the registers as follows:

MSB				IOX-8AIIS Analog Inputs											LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	300xx
—	—	—	—	x	x	x	x	x	x	x	x	x	x	x	x	
				Analog Input: 12 bit value (0–4095)												

9.6.2 Analog Input Status

There are two status bits associated with each analog input. These bits are used to indicate if the input is zero or open circuit, in the working range 0–4095, or over range. If the input is open circuit or over range, the error bit will be set. When the error bit is set, the range bit is zero if the input is open circuit, and is set if the input is over range.

Bit 1 – Error	Bit 2 – Range	Condition	Status LED
0	Any	Input working OK	Off
1	0	Open circuit or zero	On
1	1	Over range	Flashing

MSB					IOX-8AIIS Analog Input Status										LSB	Address
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30010
AI 8 Range	AI 8 Error	AI 7 Range	AI 7 Error	AI 6 Range	AI 6 Error	AI 5 Range	AI 5 Error	AI 4 Range	AI 4 Error	AI 3 Range	AI 3 Error	AI 2 Range	AI 2 Error	AI 1 Range	AI 1 Error	

10 Regulatory Compliance

10.1 EMC Compliance (CE)

CE

This product is in compliance with the EMC Directive 2004/108/EC and the Low Voltage Directive 2006/95/EC through conformance with the following standards:

- EN 55022:2011, class A
- EN 61010-1:2010
- IEC 61000-3-3:2009

- EN 61326-1:2013
- IEC 61000-4-2:2009
- IEC 61000-4-3:2008
- IEC 61000-4-4:2012
- IEC 61000-4-5:2006
- IEC 61000-4-6:2009
- IEC 61000–4–11:2005

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